

Project ESPRESSO: Exploration Roles of Handheld LIBS at the Potrillo Volcanic Field. M. H. Yant¹, K.W. Lewis¹, A.H. Parker², S.M. Hörst¹, A.C. McAdam³, C.A. Knudson^{3,4}, and the Project ESPRESSO Team. ¹Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218. ²Space Sciences Division, Southwest Research Institute, Boulder, CO 80302. ³NASA Goddard Space Flight Center, Greenbelt, MD 20771. ⁴Center for Research and Exploration in Space Sciences and Technology (CRESST)/University of Maryland College Park, College Park, MD. (marcella.yant@jhu.edu).

Introduction: A major objective of the SSERVI Project ESPRESSO (Project for Exploration Science Pathfinder Research for Enhancing Solar System Observations) investigation is to assess the role and performance of hand-held devices in the context of human space exploration while targeting specific questions of geologic interest at field analog sites. We participated in the summer 2018 field campaign of the SSERVI RIS⁴E (Remote, In Situ and Synchrotron Studies for Science and Exploration) team at the Potrillo Volcanic Field in southern New Mexico. Two SciAps Laser Induced Breakdown Spectroscopy (LIBS) instruments were used to measure the elemental composition of sequences of ash/pyroclastic material at the Kilbourne Hole maar as well as basaltic material with variable surface coatings in inflation domes elsewhere in the volcanic field.

We have used the collected data to 1) evaluate the ability of these field portable instruments to resolve meaningful geochemical trends, 2) assess the relationship of chemistry to both outcrop-scale spatial variability and small-scale sedimentological heterogeneity (ash, lithics, xenoliths, diagenetic components, etc.), and 3) compare results from multiple handheld devices between the two SSERVI teams.

Results: The handheld LIBS instrument uses univariate peak analysis which poses challenges with geochemically diverse samples because of chemical matrix effects. When a sample matrix is unknown, the accuracy of a univariate calibration is limited by how well the calibration matrix is able to match the sample matrix. Mismatch of matrix between standards and unknowns can result in large analytical uncertainties. The two handheld LIBS instruments each used a different calibration method. Project ESPRESSO employed the default calibration and RIS⁴E utilized a custom calibration.

Our study area included sequences of ash/pyroclastic material at the Kilbourne Hole maar which exhibited multiple grain sizes, sorting, and textures within a relatively small sequence (~6 m).

LIBS was used to determine if distinct chemistries could be observed for the surface coatings relative to each other as well as for the underlying rock relative to the surface coatings using the default instrument calibration. Certain elements provided smaller error bars which allows for finer scale differences to be observed between the materials. In order to improve the accuracy of this instrument calibration targets with compositions analogous to the field targets are critical and currently being investigated.

Following the field campaign, we built several calibrations from a suite of well-characterized pressed pellets from rock powder standards of the Mount Holyoke College Mineral Spectroscopy Laboratory. The standards chosen for univariate analyses vary in elemental abundances but have compositions that are found naturally within rocks. We will present a reevaluation of our data using this more extensive calibration.



Figure 1: Map of Potrillo Volcanic Field.